



## MAGNETIC NANOSTRUCTURES

Led by ICREA Prof. Josep Nogués, the Magnetic Nanostructures Group investigates different types of magnetic nanostructures with the aim of improving their functional properties. The group combines state of the art lithographic or chemical synthesis methods with structural, morphological and magnetic characterisation to focus on three areas; magnetic properties of lithographed magnetic nanostructures, magnetic nanoparticles and other non-nanometric systems.

### BACKGROUND

Magnetic lithographed nanostructures are at the heart of most spintronic devices (e.g., magnetic random access memories – MRAM or sensors). Similarly, magnetic nanoparticles have demonstrated a potential in a broad range of disciplines, from medical applications to magnetic recording. At the same time, these types of systems exhibit a variety of novel properties which have not been exploited in applications.

Aside from patterning (varying the size, shape or distance), the magnetic properties of nanostructures can be considerably modified by different types of interactions with other magnetic materials.

Magnetic nanoparticles have long been studied due to their wide range of novel fundamental properties and wide range of appli-

cations. Interestingly, the required magnetic properties depend widely on the type of application. Thus, the magnetic properties of nanoparticles often need to be adjusted to match specific purposes.

### RESEARCH ACTIVITIES INCLUDE:

#### Advancing the understandings of the basic magnetic properties of nanoparticles and nanostructures.

The Group is working to identify how the different parameters (shape, interactions, magnetic phases, etc.) affect the magnetic properties, with the goal of tuning the properties to match specific applications.

#### Development of exchange coupled nanostructures.

Deepening the understanding of magnetic exchange interactions in lithographed magnetic nanostructures by controlling their magnetic properties through the extra degree of freedom given by interactions, and studying the role of different parameters of the constituent magnetic materials (e.g., anisotropy) on the overall magnetic properties.

#### Development of core-shell nanoparticles.

The Group is investigating the role of different magnetic materials, with diverse properties, on the magnetic properties of core-shell nanoparticles. The goal is to tailor the overall magnetic properties of the nanoparticle by controlling the structural (e.g., core diameter or shell thickness) and magnetic (e.g., type of material or anisotropy) properties of the constituents.



**ICREA PROF. JOSEP NOGUÉS**  
GROUP LEADER

Prof. Nogués attained his BSc from the Universitat Autònoma de Barcelona (Spain) in 1986 and after obtaining his PhD in the Royal Institute of Technology (Stockholm, Sweden) in 1993, he moved to the University of California San Diego for post-doctoral studies. In 1997 he returned to the Universitat Autònoma de Barcelona. He is currently an ICREA Research Professor and group leader of the Magnetic Nanostructures Group at the Catalan Institute of Nanotechnology (ICN) in Barcelona, Spain. Dr. Nogués has published over 180 articles (including 7 reviews) - with more than 7000 citations and an h-index of 36-, he has 2 patents and he has presented over 100 invited talks.

